Working Document presented to the Working Group on Elasmobranch Fishes

ICES WGEF, - June 2014

Results on main elasmobranch species captured during the 2001-2013 Porcupine Bank (NE Atlantic) bottom trawl surveys

S. Ruiz-Pico (1), F. Velasco (1), F. Baldó (2),
C. Rodríguez-Cabello (1), O. Fernández-Zapico (1)

(1) Instituto Español de Oceanografía, Centro Oceanográfico de Santander
P.O. Box 240, 39080 Santander, Spain
(2) Instituto Español de Oceanografía, Centro Oceanográfico de Cádiz
Puerto pesquero, Muelle de Levante s/n, 11006 Cádiz, Spain

Abstract

This working document presents the results on the most significant elasmobranch species of the Porcupine Bank Spanish surveys in 2013. The main species in biomass terms in this survey were Galeus melastomus (blackmouth catshark), Deania calcea (birdbeak dogfish), Deania profundorum (arrowhead dogfish), Scyliorhinus canicula (lesser spotted dogfish), Scymnodon ringens (Knifetooth dogfish), Etmopterus spinax (velvet belly lantern shark), Dalatias licha (Kitefin shark) Hexanchus griseus (bluntnose sixgill shark), Leucoraja circularis (sandy ray), Leucoraja naevus (cuckoo ray), Dipturus nidarosiensis (Norwegian skate) and Dipturus spp. / Dipturus cf. flossada / Dipturus cf. intermedia (common skate). Biomass, distribution and length ranges were analysed. Many of these species occupy mainly the deep areas covered in the survey, especially D. calcea, D. profundorum and S. ringens.

Introduction

The Porcupine Bank bottom trawl survey has been carried out annually since 2001 in order to provide data and information for the assessment of the commercial fish species in the area (ICES divisions VIIc and VIIk) (ICES, 2010, 2011).

The aim of this working document is to update the results (abundance indices, length frequency distributions and geographic distributions) on the most common elasmobranch species in Porcupine bottom trawl surveys after the results presented previously (Velasco *et al.*, 2010; Fernández-Zapico *et al.*, 2011; Ruiz-Pico et al., 2012; Fernández-Zapico *et al.*, 2013). The species analysed were: *Galeus melastomus* (blackmouth catshark), *Deania calcea* (birdbeak dogfish), *Deania profundorum* (arrowhead dogfish), *Scyliorhinus canicula* (lesser spotted dogfish), *Scymnodon ringens* (Knifetooth dogfish), *Etmopterus spinax* (velvet belly lantern shark), *Dalatias licha* (Kitefin shark), *Hexanchus griseus* (bluntnose sixgill shark), *Leucoraja circularis* (sandy ray), *Leucoraja naevus* (cuckoo ray), *Dipturus nidarosiensis* (Norwegian skate) and *Dipturus* spp./ *Dipturus cf. flossada* / *Dipturus cf. intermedia* (common skate).

Material and methods

The area covered in the Spanish Ground Fish Survey on the Porcupine bank (SPPGFS) (Figure 1) extends from longitude 12° W to 15° W and from latitude 51° N to 54° N following the standard IBTS methodology for the western and southern areas (ICES, 2010).The sampling design was random stratified (Velasco and Serrano, 2003) with two geographical sectors (North and South) and three depth strata (> 300 m, 300 – 450 m and 450 - 800 m) (Figure 2). Hauls allocation is proportional to the strata area following a buffered random sampling procedure (as proposed by Kingsley *et al*., 2004) to avoid the selection of adjacent 5×5 nm rectangles. More details on the survey design and methodology are presented in ICES (2010, 2011).

A revision of haul duration standardization was carried out this last year, with views to change the abundance estimation from time based to sweep area instead on time. Historically, stratified biomass and abundance index have been estimated per 30 minutes tow starting from the end of warp shooting. Nevertheless yearly differences in time to reach the ground produced differences in the actual trawling time that was actually overestimated. Using the logs of the net monitoring system (SIMRAD ITI) times to ground contact have been re-estimated, and abundances have been weighted to 30 minutes. Total catch with "standard" 30 minutes and total catch with tow duration reviewed with ground contact vary depending on the depth and gear behaviour that was not uniform along the time series, but considering the total catch vary between 10 to 40% (Figure 3), with 2008 and 2009 presenting the larger differences. For first time, in this present work, the correction is applied to the elasmobranch fish species catches in the overall time series, thus the biomass and abundance indices are higher than the ones previously reported, but the overall relative abundances have not changed much between years.

Results and discussion

In 2013, 80 standard hauls and 5 additional hauls were carried out (Figure 2).

As described above, the total catch of the whole time series has increased as a result of the the tow duration correction made. In 2013, mean total catch per haul was therefore 1069.6 ± 79.59 Kg with tow duration corrected instead of 898.8 ± 67.9 kg with standard 30 minutes (Figure 3). From now, all the results presented in this report are those with the haul duration weighted to 30 minutes.

In this last survey, fishes represented about 95% of the total catch and elasmobranchs made up ca. 6% of the total fish catch. The shark species registered in 2013 in the sampling area, and their respective percentages of the total elasmobranchs stratified catch were: *Galeus melastomus* (64%), *Deania calcea* (13%), *Deania profundorum* (0.04%), *Scyliorhinus canicula* (8%), *Scymnodon ringens* (5%), *Etmopterus spinax* (1.7%), *Hexanchus griseus* (2%) and *Dalatias licha* (0.6%). The skate and rays species were: *Leucoraja naevus* (0.2%), *Leucoraja circularis* (1.5%), *Dipturus* spp. (*Dipturus nidarosiensis* (1.5%), *Dipturus cf. flossada* (1.3%) and *Dipturus cf. intermedia* (0.2%)) and *Rajella fyllae* (0.03%).

The most remarkable changes in 2013 compared to previous years were the steep increase on the biomass of *S. canicula* in the north of Irish shelf, the decreasing trend of the small sizes (< 65 cm) of *D. calcea* even reaching zero values, the larger catches of big but also small specimens of *D. cf. flossada* and the first record of *D.s cf. intermedia* in the survey area.

***Galeus melastomus* (Blackmouth catshark)**

A decrease in biomass and abundance of *G. melastomus* respecting 2012 abundance, was found in 2013 survey, although the value was still higher than the previous eleven years of the time series (Figure 4).

In 2013, *G. melastomus* was caught between 227 m and 738 m, although it was mainly found in the deepest part of the southern sector of the survey area, between 450 m and 800 m, like in the previous years (Figure 5).

Blackmouth catshark length size in the last survey ranged from 12 cm to 79 cm. This year a similar size distribution 2012 was found, with three peaks and only a marked one mode around 65 cm (Figure 6).

***Deania calcea* (Birdbeak dogfish) and *Deania profundorum* (Arrowhead dogfish)**

As shown in the previous working document (Fernández-Zapico et al., 2013), *D. profundorum* was likely recorded together with *D. calcea* before 2012. Now it is possible to do a comparative analysis between these two species in the last two years.

D. calcea remains representing much more higher percentage of the elasmobranch mean stratified catch than *D. profundorum*, specially this last year when biomass of *D. calcea* increased whereas *D. profundorum* decreased (Figure 7; Figure 8). Even so and as reported previously (Velasco et al., 2010), the stratified biomass and abundance of *D. calcea* was quite variable in the overall time series may be due to the fact that this species dwells in the depth limits covered in this survey, as reported previously (Velasco et al., 2010).

Both species show a deep distribution below 400 m. In 2013, *D. calcea* was found between 490 m and 738 m and the few specimens of *D. profundorum* extended from 543 m to 664 m. *D. calcea* was abundant in the south and north of the westernmost area while *D. profundorum* was not found in the north (Figure 9; Figure 10). Even so, the scarcity of *D. profundorum* did not allow us to infer yet any conclusions or trends on the distribution of the species in the area.

Regarding length distributions, in 2013, *D. calcea* ranged from 70 cm to 113 cm with one marked mode around 87 cm and a smaller one around 105 cm, similar to the modes found in previous years (Figure 11). After the decreasing trend of small specimens in the last years, no individuals smaller than 65 cm were found in this last survey (Figure 12). On the other hand, the three specimens of *D. profundorum* sized 35 cm, 64 cm and 68 cm in 2013, not appearing the big sizes of 2012.

***Scyliorhinus canicula* (Lesser spotted dogfish)**

A steep increase in the biomass of *S. canicula* was found in this last survey, the biomass catch increased from 2.0 $Kg\cdot haul^{-1}$ in 2012 to 5.7 $Kg\cdot haul^{-1}$ in 2013, the largest value of the overall time series (Figure 13).

In 2013, *S. canicula* was found between 195 m and 438 m. Although in the time series *S. canicula* was distributed around the bank, the geographic distribution of biomass was also clearly related to the Irish shelf, as reported before (Velasco *et al*., 2010; Fernández-Zapico *et al*., 2011; Ruiz-Pico et al., 2012; Fernández-Zapico *et al*., 2013), even more this last year, with a high capture in the northern part of the Irish shelf (Figure 14**¡Error! No se encuentra el origen de la referencia.**).

Lesser spotted dogfish length distribution found in 2013 ranged between 33 cm and 79 cm with a wide mode around 60 cm (Figure 15). In contrast to the lack of small sizes in the 2012, some individuals from 33 cm to 40 cm were shown in 2013, although the sizes are not as small as those in 2007 and 2008, when specimens from 17 cm were reported (Velasco *et al.*, 2010). The higher biomass and abundance in the Northern Irish shelf in 2013 may correspond again to the apparition of these small sizes, as it was suggested previously (Velasco *et al.*, 2010; Fernández-Zapico *et al.*, 2013)

***Scymnodon ringens* (Knifetooth dogfish)**

A slight decrease in biomass and abundance of *S. ringens* was found in this last survey after the increasing trend of the last four years (Figure 16).
In 2013, *S. ringens* was caught from 597 m to 738 m and it was found on the slope of the Porcupine Seabight southeast of the survey area, like in previous years, although with smaller presence in the east (Figure 17).
The *S. ringens* sizes ranged between 33 cm and 110 cm in 2013 with more individuals of around 73 cm (Figure 20). Lesser abundance of the small individuals was found this last survey in contrast to the previous years.

***Etmopterus spinax* (Velvet belly)**

The stratified biomass and abundance remained within the low values of the last years, even lower than the year before (Figure 16).
E. spinax dwelled from 333 m to 734 m in 2013, showing a deep distribution like *S. ringens*, but in contrast, higher biomass was found close of the central mound of Porcupine Bank in the northwest and southeast part in 2006 and 2009. In 2013, deeper and shallower distribution was also showed although with low values and some more specimens were found on the slope south of the survey area than the previous years (Figure 18).
E. spinax showed similar length distribution in 2013 than the previous year, a narrow length range between 11 cm to 53 cm without a mode in 37-38 cm (Figure 21), being the mode of the whole time series 37 cm. Due to the small size of this species and despite its high abundance, the biomass is very low, in contrast with *S. ringens* and *D. licha*.

***Dalatias licha* (Kitefin shark)**

This scarce elasmobranch increased its biomass this last year, reaching values around 0.4 $Kg\cdot haul^{-1}$, similar to 2011 (Figure 16).
D. licha extended between 399 m and 709 m in 2013. Like in other years, the few specimens were found mainly on the western slope of the Porcupine Seabight, although a single haul in the eastern slope of the bank also is one of the remarkable point for this species most of the years (Figure 19).
Kitefin shark length distribution found in 2013 ranged between 40 cm and 119 cm, with some longer specimens than previous year, reaching the longest size of 119 cm of the overall time series (Figure 22).

***Hexanchus griseus* (Bluntnose sixgill shark)**

The biomass and abundance of this scarce shark increased again this last year (Figure 23), reaching the peak of the time series.
In 2013, *H. griseus* was caught between 263 m and 703 m. It was widespread in the sampling area with no clear pattern in the geographical distribution (Figure 24).
H. griseus length distribution ranged from 67 cm to 130 cm in 2013 (Figure 25).

***Leucoraja circularis* (Sandy ray) and *Leucoraja naevus* (Cuckoo ray)**

A slight increase in biomass of *L. circularis* from 0.82 $Kg\cdot haul^{-1}$ in 2012 to 1.06 $Kg\cdot haul^{-1}$ in 2013 was found this last survey, following the increasing trend of the three previous years. On the other hand, *L. naevus* remained in the low values of the six previous years, reaching the lowest value of the overall time series (0.16 $Kg\cdot haul^{-1}$) this last year (Figure 26).

The contrasting distribution of these two rays is marked in the overall time series. This last year, *L circularis* was found from 333 m to 670 m throughout the west survey area, whereas *L. naevus* was found from 208 m to 310 m around the central mound of Porcupine Bank, with smaller biomass located in the southern part of the central mound than the previous surveys (Figure 27).
In 2013, the sizes of the few specimens of *L. naevus* ranged from 34 cm to 60 cm, whereas *L. circularis* showed a wider length range from 25 cm to 101 cm (Figure 28).

***Dipturus* spp. (Common skate)**

After the careful identification of the species of genera *Dipturus* in the two previous surveys (Ruiz-Pico et al., 2012; Fernández-Zapico *et al*., 2013), now it is possible to do a comparative analysis between these species in the last three years. In 2013, *Dipturus nidarosiensis, Dipturus cf. flossada and Dipturus cf. intermedia* were found.
An important increase in number but a decrease in biomass of *Dipturus* spp. was found in 2013 (Figure 29). Particularly, the biomass and abundance of *D. nidarosiensis* decreased whereas *D. cf. flossada* increased markedly this last year (Figure 32; Figure 33). Both species showed similar biomass around 1 $Kg \cdot haul^{-1}$ but whereas fifteen individuals of *D. cf. flossada* were found, just two big specimens of *D. nidarosiensis* were caught. Moreover, two specimens of *D. cf. intermedia* were found in 2013 for the first time in the last three surveys (Figure 33).
Dipturus spp. extended from 195 m to 738 m. Like in previous surveys (Ruiz-Pico et al., 2012; Fernández-Zapico *et al*., 2013), in 2013, it was mainly found shallower around the central mound of Porcupine Bank, corresponding to *D. cf. flossada* distribution, and deeper than 700 m on the slope of the Porcupine Seabight south of the survey area, corresponding to the *D. nidarosiensis* distribution (Figure 34). The few specimens of *D. cf. intermedia* were found in the north of the Irish shelf at 228 m and 284 m (Figure 34).
Regarding length distribution in 2013, *Dipturus spp.* ranged from 41 cm to 150 cm, corresponding the big sizes to *D. nidarosiensis* (128 -150 cm) and the small ones to *D. cf. flossada* (41-143 cm) and *D. cf. intermedia* (64-98 cm) (Figure 35; Figure 36). The wide size range of *D. cf. flossada* was found in this last survey for first time in the last three years due to the remarkable increase in its abundance.

Other elasmobranch species

Other scarce species were found in the area, namely *Centroscymnus coelolepis*, *Centroscymnus crepidater*, *Centrophorus squamosus*, *Galeus murinus*, *Galeorhinus galeus*, *Raja clavata*, *Leucoraja fullonica* and *Rajella fyllae.* However, in 2013 only 3 specimens of *Rajella fyllae* were caught in one haul at 664 m, two males of 45 cm and 46 cm and one female of 46 cm.

Acknowledgements

We would like to thank R/V Vizconde de Eza crews and the scientific teams from IEO, Marine Institute and AZTI that made the Porcupine Surveys possible.

References

Fernández-Zapico O., Velasco F., Baldó F., Ruiz-Pico S., and Blanco M., 2011. Results on main elasmobranch species captured during the 2001-2010 Porcupine Bank (NE Atlantic) bottom trawl surveys. Working Document presented to the Working Group on Elasmobranch Fishes ICES WGEF, 22-24 June 2011. 22 pp.

Fernández-Zapico O., Velasco F., Baldó F., Rodríguez-Cabello C., Ruiz-Pico S., 2013. Results on main elasmobranch species captured during the 2001-2012 Porcupine Bank (NE Atlantic) bottom trawl surveys. Working Document presented to the Working Group on Elasmobranch Fishes ICES WGEF, 17-21 June 2012. 22 pp.

ICES, 2011. Report of the International Bottom Trawl Survey Working Group (IBTSWG), 28 March - 1 April 2011, Copenhage, Denmark. ICES CM 2011/SSGESST: 06. 237 pp.

ICES, 2010. Manual for the International Bottom Trawl Surveys in the Western and Southern Areas Revision III Agreed during the meeting of the International Bottom Trawl Survey Working Group 22–26 March 2010, Lisbon. Addendum 2: ICES CM 2010/SSGESST:06. 58 pp.

Kingsley, M.C.S.; Kanneworff, P. and Carlsson, D.M., 2004. Buffered random sampling: a sequential inhibited spatial point process applied to sampling in a trawl survey for northern shrimp Pandalus borealis in West Greenland waters. ICES Journal of Marine Science, 61: 12-24.

Ruiz-Pico S., Baldó F., Velasco F., Fernández-Zapico O., Rodríguez-Cabello C., 2012. Results on main elasmobranch species captured during the 2001-2011 Porcupine Bank (NE Atlantic) bottom trawl surveys. Working Document presented to the Working Group on Elasmobranch Fishes ICES WGEF, 18-26 June 2012. 22 pp.

Velasco, F., and Serrano, A., 2003. Distribution patterns of bottom trawl faunal assemblages in Porcupine bank: Implications for Porcupine surveys stratification design. Working Document presented to IBTSWG 2003. 19 pp.

Velasco F., Blanco M. Baldó F., 2010. Results on main elasmobranch species captured during the 2001-2009 Porcupine Bank (NE Atlantic) bottom trawl surveys. Working Document presented to the Working Group on Elasmobranch Fishes ICES WGEF, Açores - 22-29 June 2010. 26 pp.

Figures

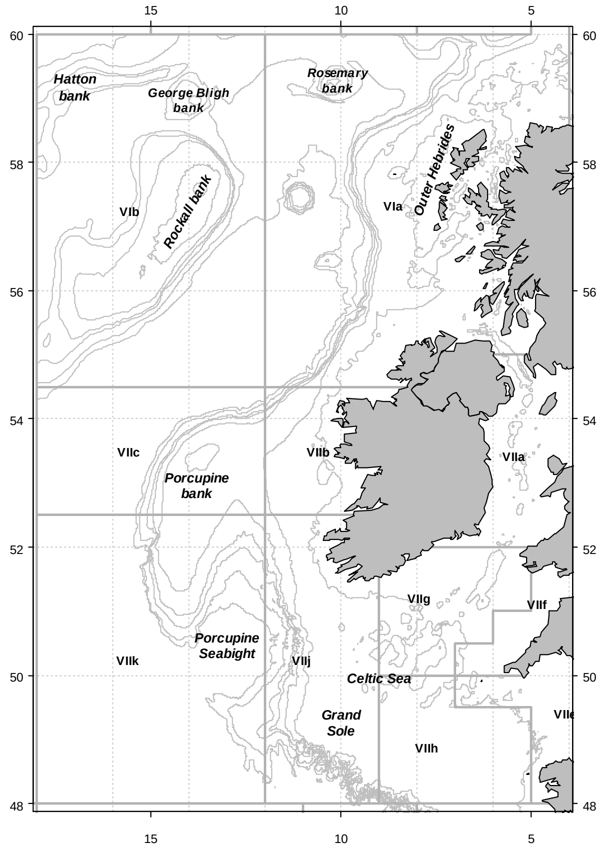

Figure 1 North eastern Atlantic showing the Porcupine bank, Porcupine Seabight, and ICES divisions.

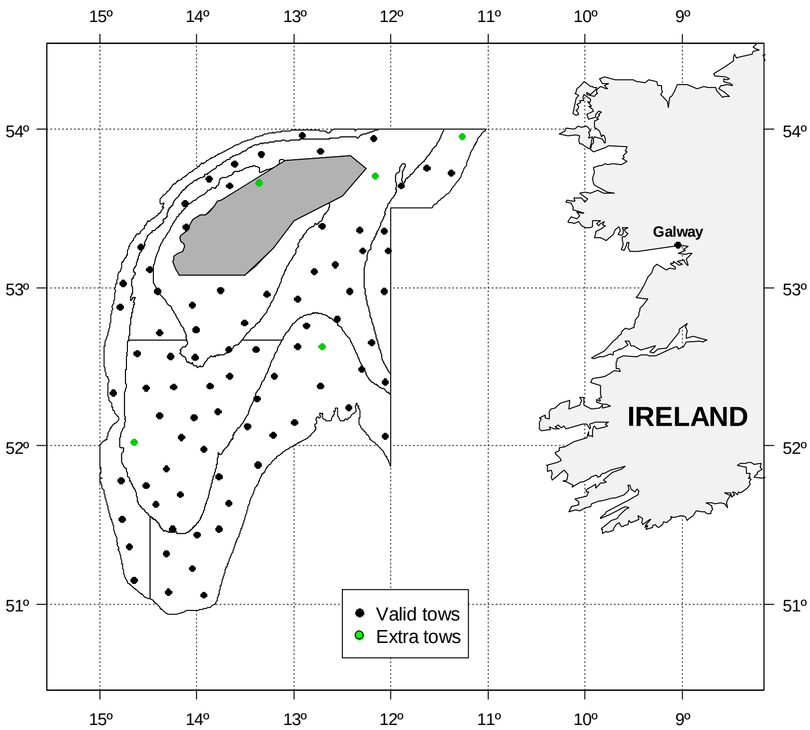

Figure 2 Stratification design and hauls in 2013 Porcupine surveys; Straight lines show geographical sectors (North and South) and the isobaths delimit the three depth strata (> 300 m, 300 – 450 m and 450 - 800 m).

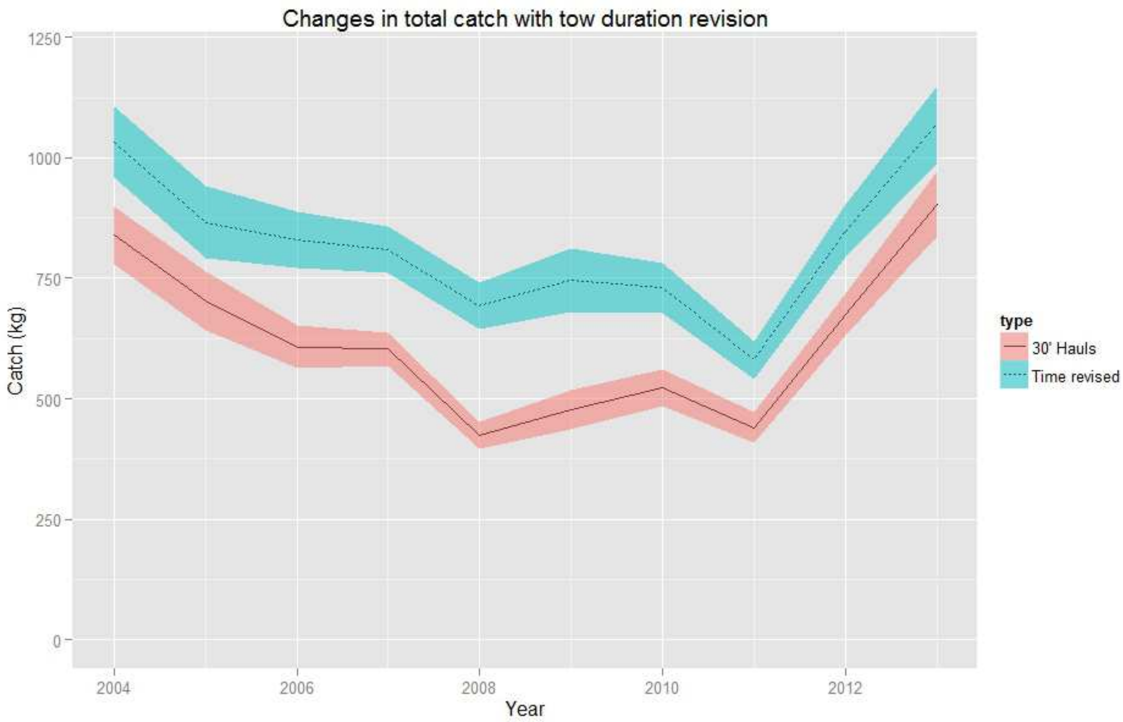

Figure 3 Comparison of evolution in total catch biomass during Porcupine Survey time series (2001-2013) with “standard” 30 min tow duration and with the tow duration corrected with ground contact. Lines mark parametric standard error of the stratified biomass.

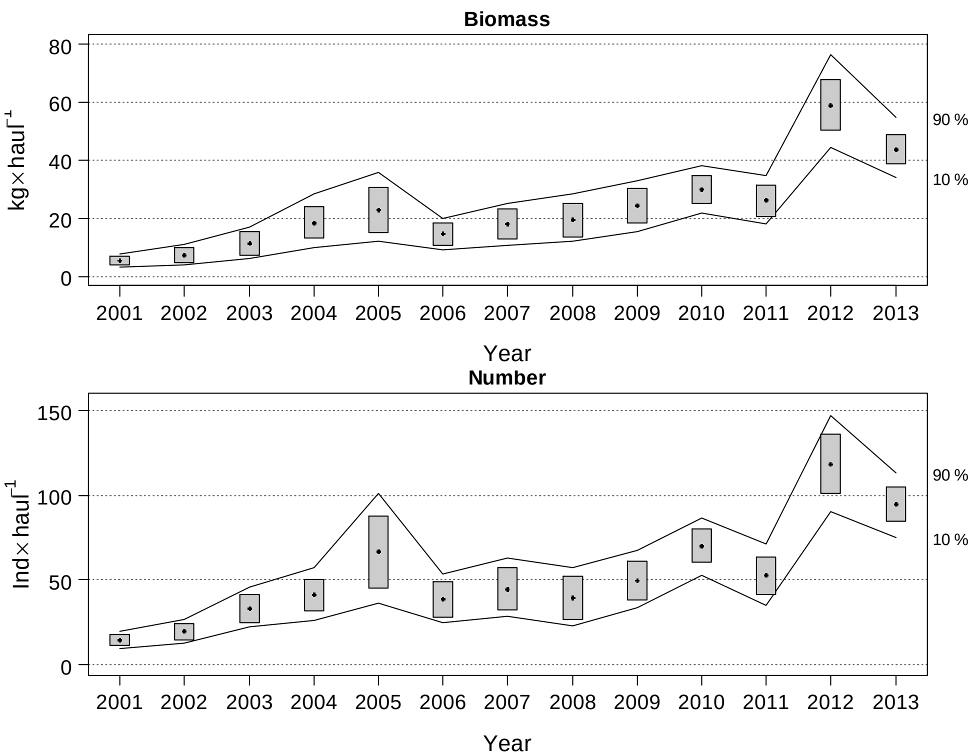

Figure 4 Changes in *Galeus melastomus* biomass index and abundance during Porcupine survey time series (2001-2013). Boxes mark parametric standard error of the stratified biomass index. Lines mark bootstrap confidence intervals (a = 0.80, bootstrap iterations = 1000).

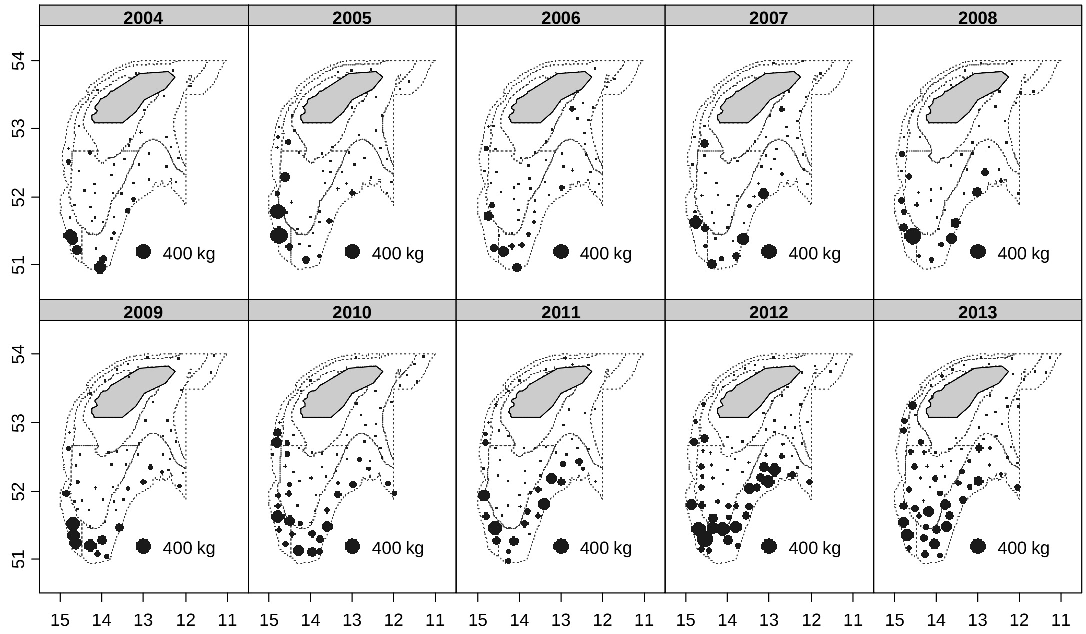

Figure 5 Geographic distribution of *Galeus melastomus* catches (kg·haul^{-1}) during Porcupine survey time series (2004- 2013)

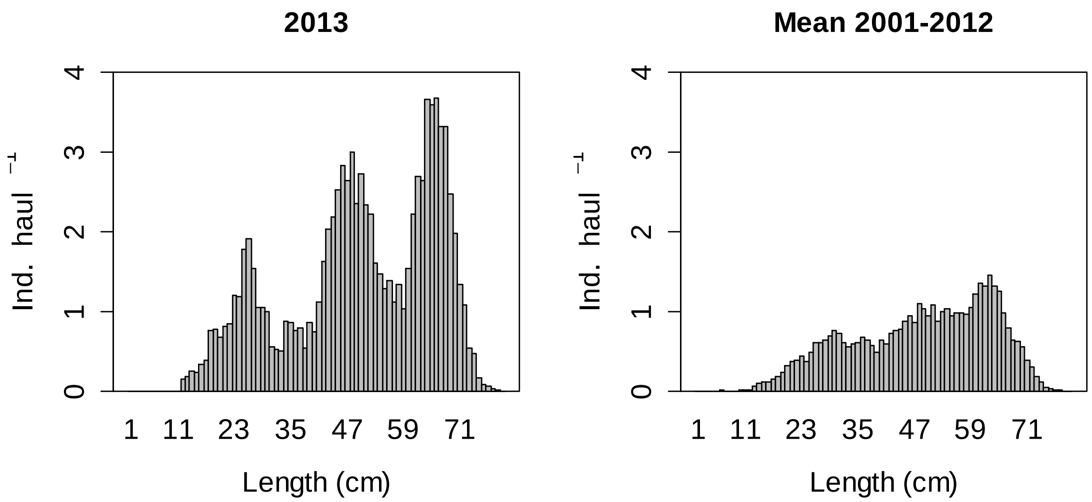

Figure 6 Stratified length distributions of *Galeus melastomus* in 2013 Porcupine survey, and mean values during Porcupine survey time series (2001-2012).

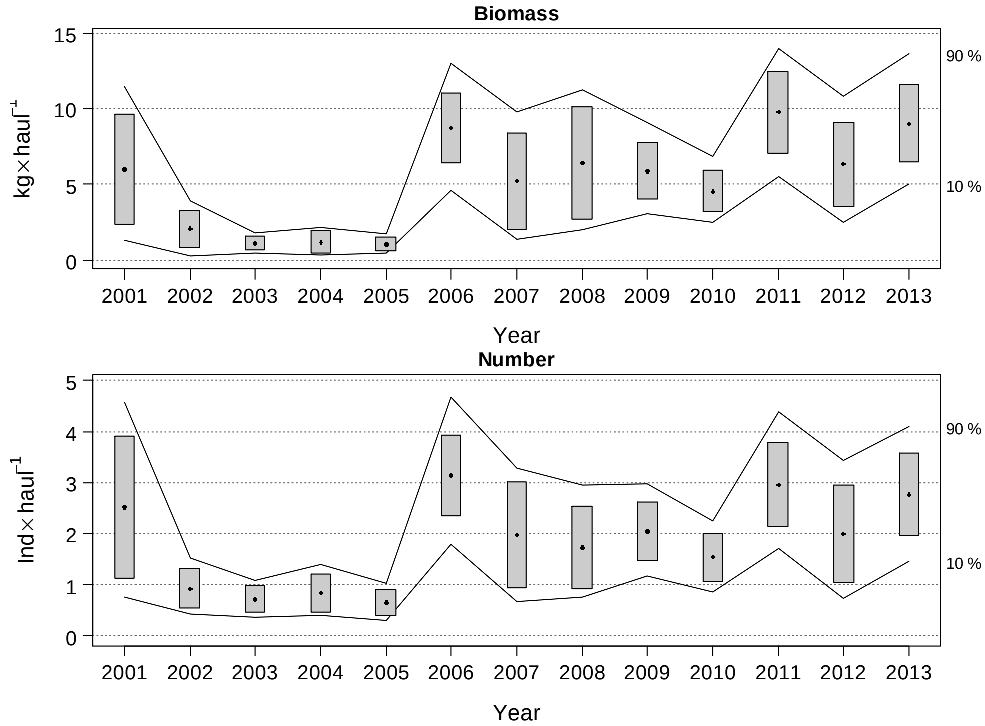

Figure 7 Changes in *Deania calcea* biomass index (kg·haul^{-1}) during Porcupine survey time series (2001-2013). Boxes mark parametric standard error of the stratified biomass index. Lines mark bootstrap confidence intervals (a = 0.80, bootstrap iterations =1000).

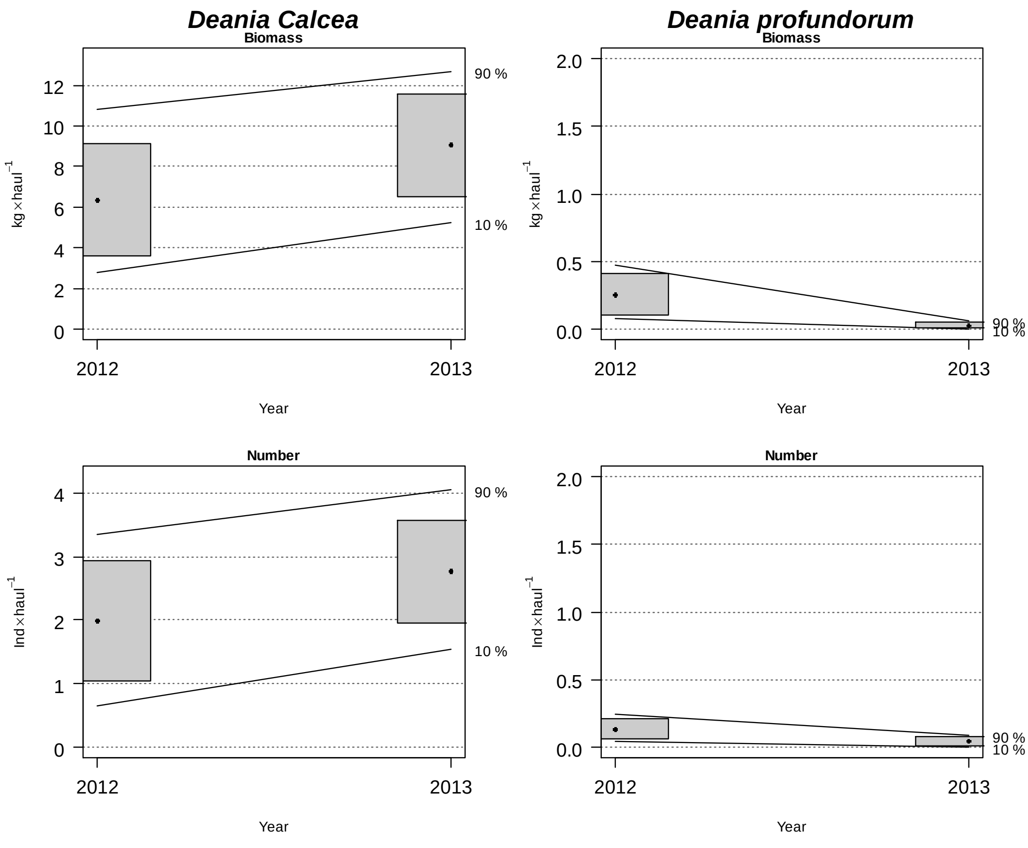

Figure 8 Changes in *Deania calcea* and *Deania profundorum* biomass index (kg·haul^{-1}) in 2012 and 2013 Porcupine surveys. Boxes mark parametric standard error of the stratified biomass index. Lines mark bootstrap confidence intervals (a = 0.80, bootstrap iterations =1000).

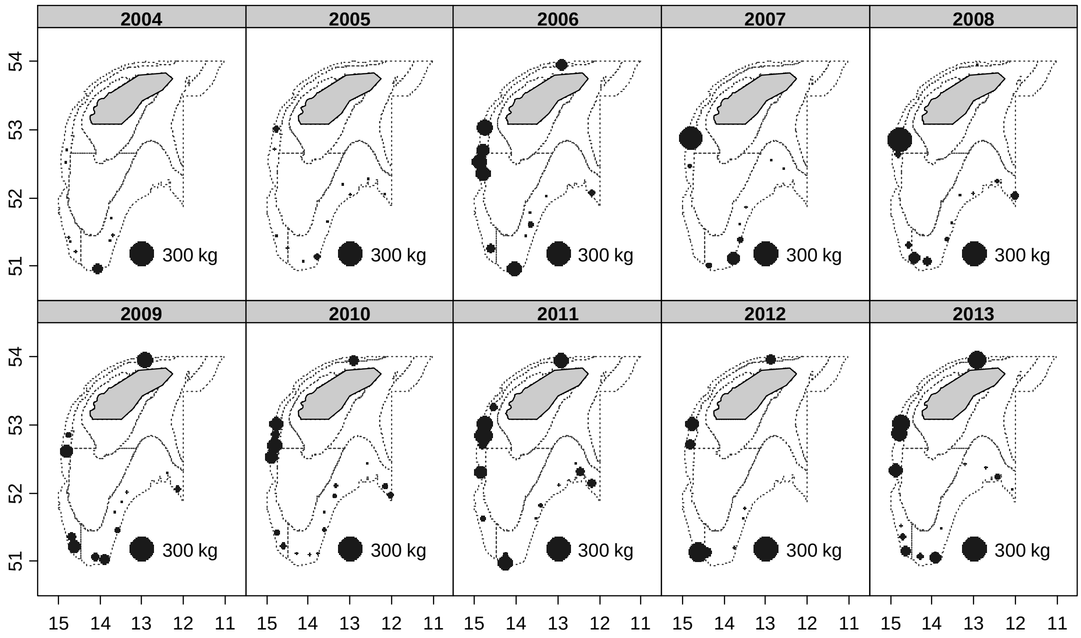

Figure 9 Geographic distribution of *Deania calcea* catches (kg·haul^{-1}) during Porcupine survey time series (2004- 2013).

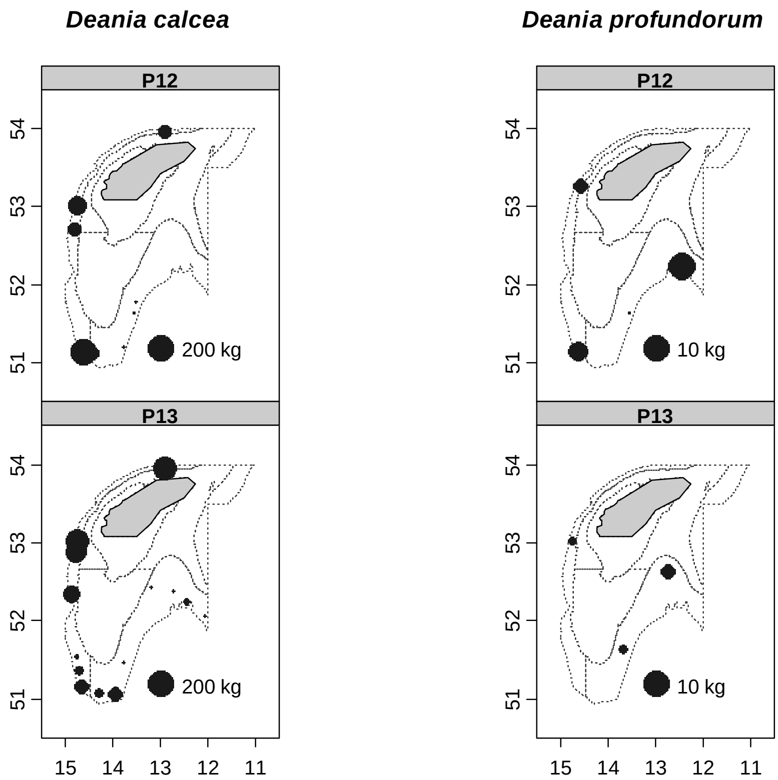

Figure 10 Geographic distribution of *Deania calcea* and *Deania profundorum* catches (kg·haul^{-1}) 2012 and 2013 Porcupine surveys.

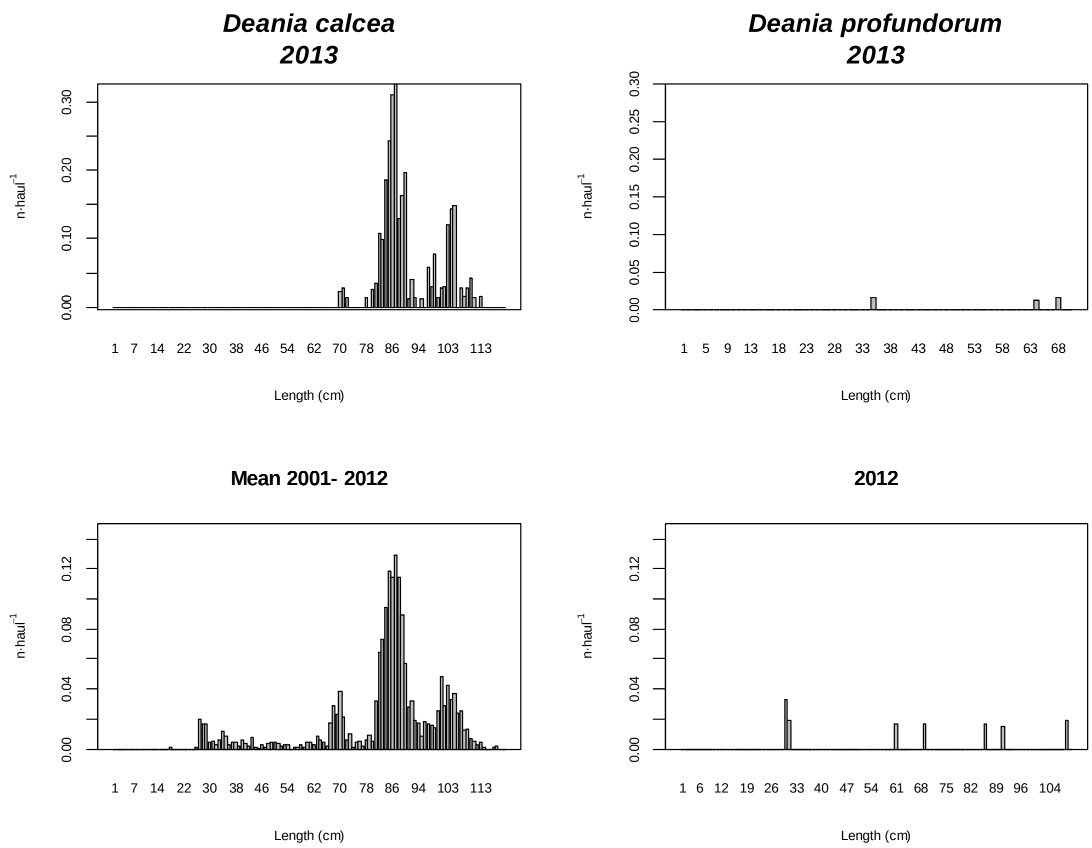

Figure 11 Stratified length distribution of *Deania calcea* and *Deania profundorum* in 2013 and 2012 Porcupine surveys, and mean values along Porcupine surveys 2001 and 2012.

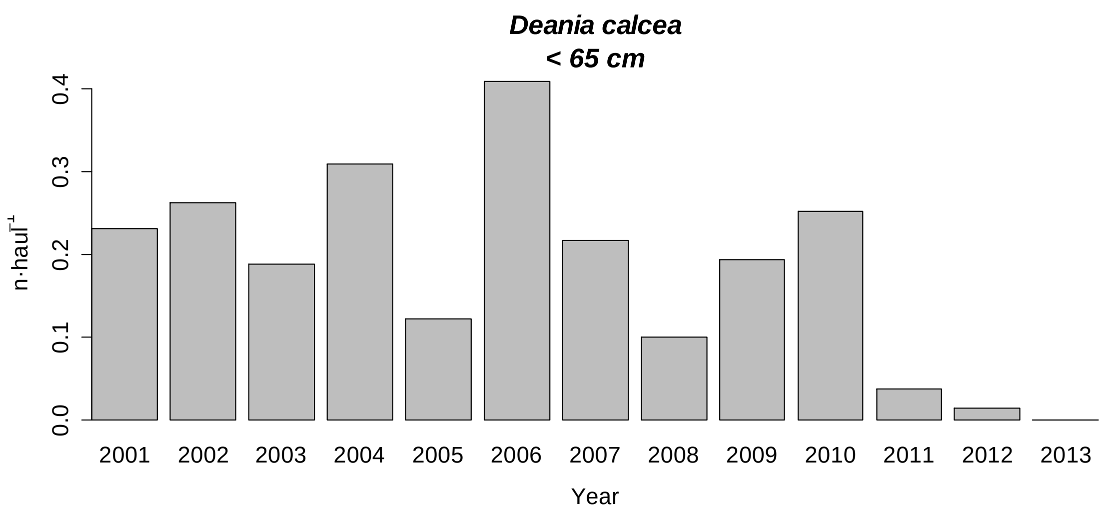

Figure 12 Abundance of *Deania calcea* smaller than 65 cm during Porcupine survey time series (2001-2013).

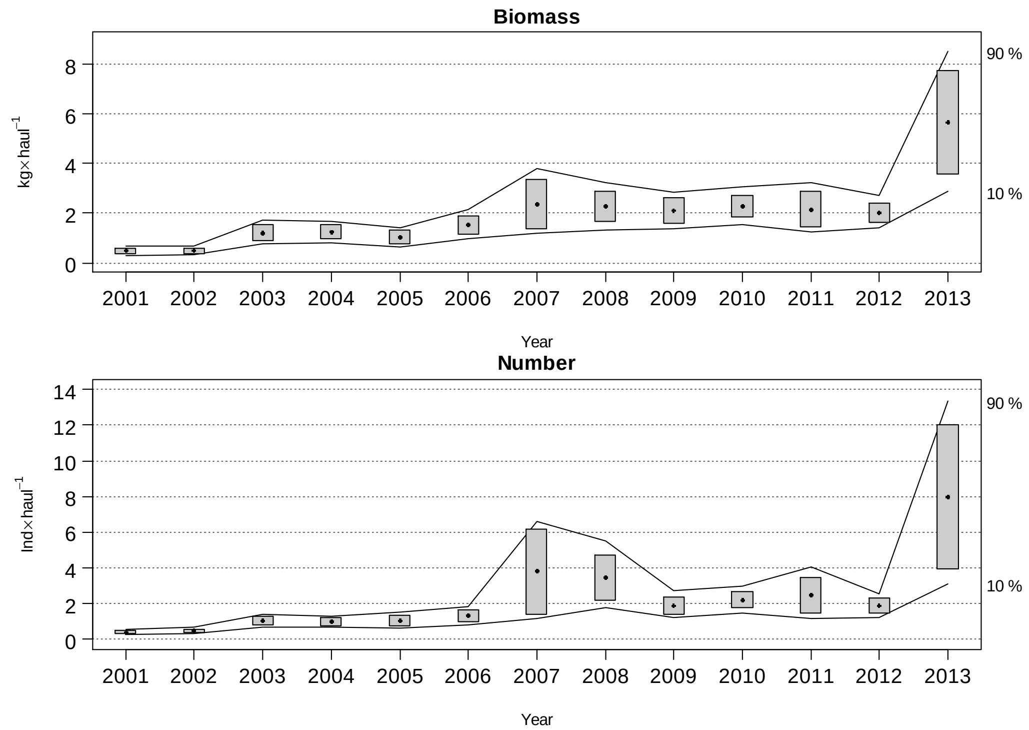

Figure 13 Changes in *Scyliorhinus canicula* biomass index (kg·haul[-1]) during Porcupine survey time series (2001-2013). Boxes mark parametric standard error of the stratified biomass index. Lines mark bootstrap confidence intervals (a = 0.80, bootstrap iterations = 1000).

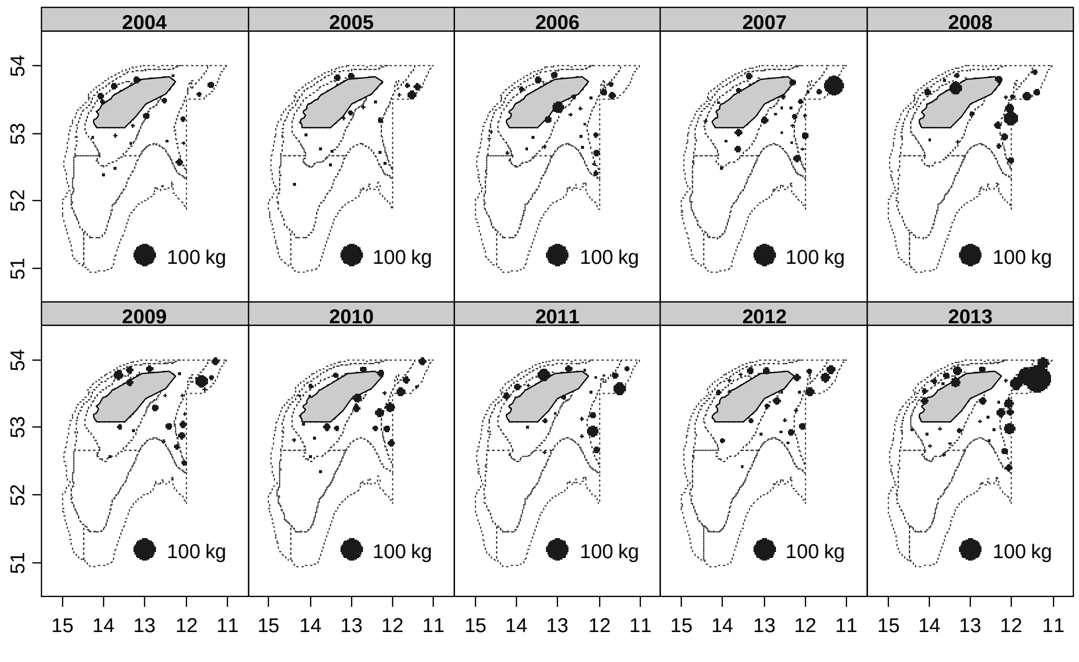

Figure 14 Geographic distribution of *Scyliorhinus canicula* catches (kg·haul[-1]) in Porcupine survey time series (2004-2013).

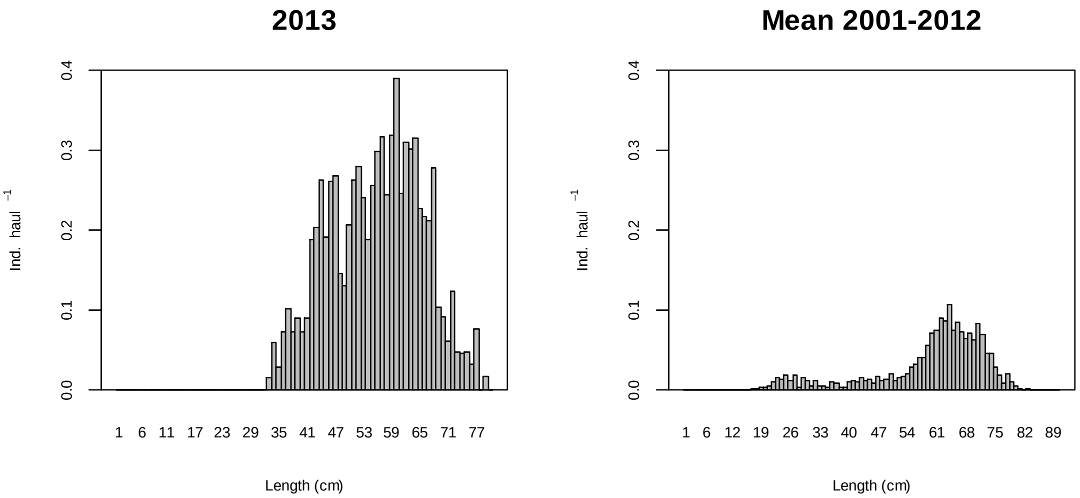

Figure 15 Stratified length distributions of *Scyliorhinus canicula* in 2013 in Porcupine survey, and mean values during Porcupine survey time series (2001-2012).

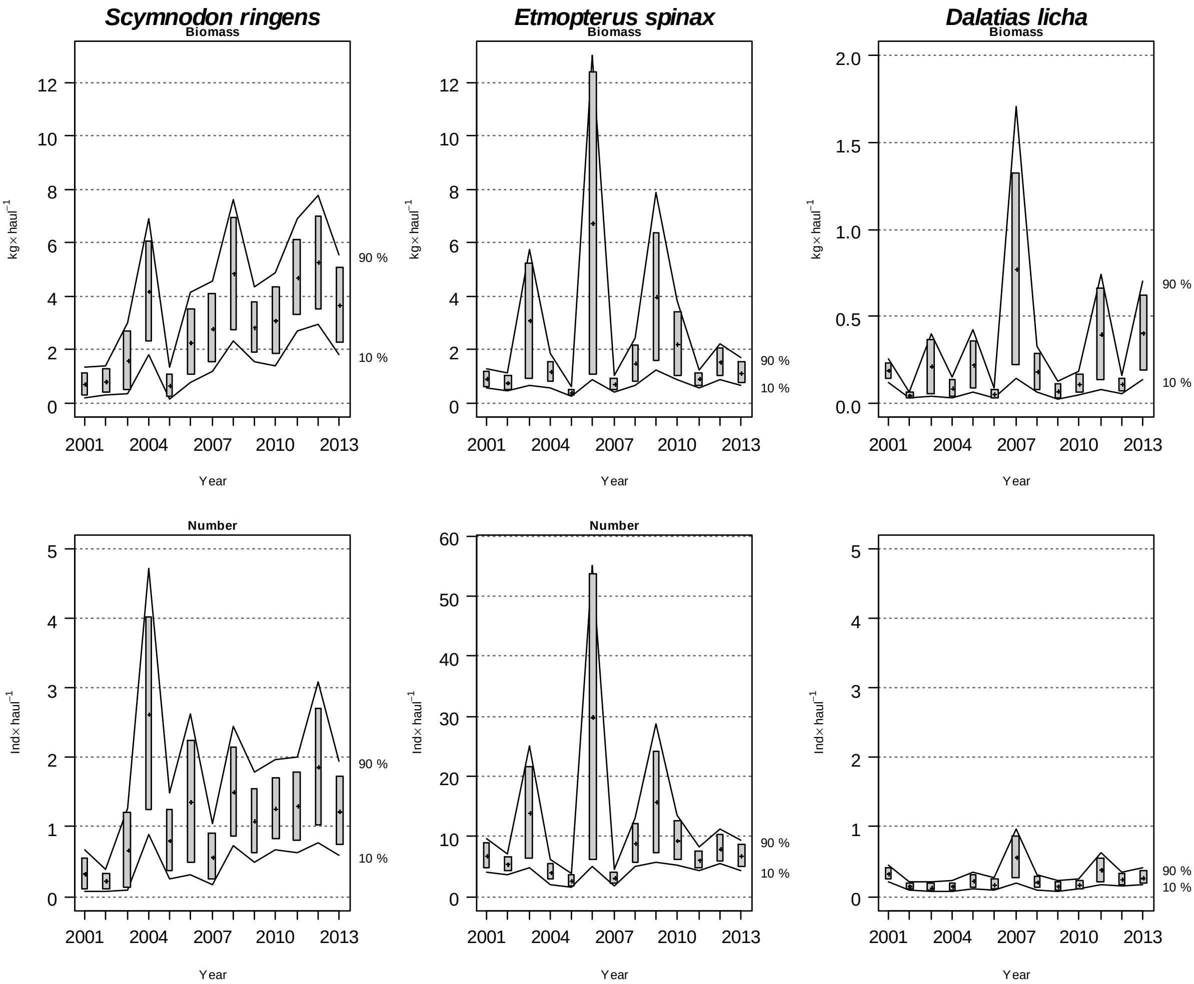

Figure 16 Changes in *Scymnodom ringens*, *Etmopterus spinax* and *Dalatias licha* biomass index (kg· haul^{-1}) during Porcupine survey time series (2001-2013). Boxes mark parametric standard error of the stratified biomass index. Lines mark bootstrap confidence intervals (a = 0.80, bootstrap iterations = 1000).

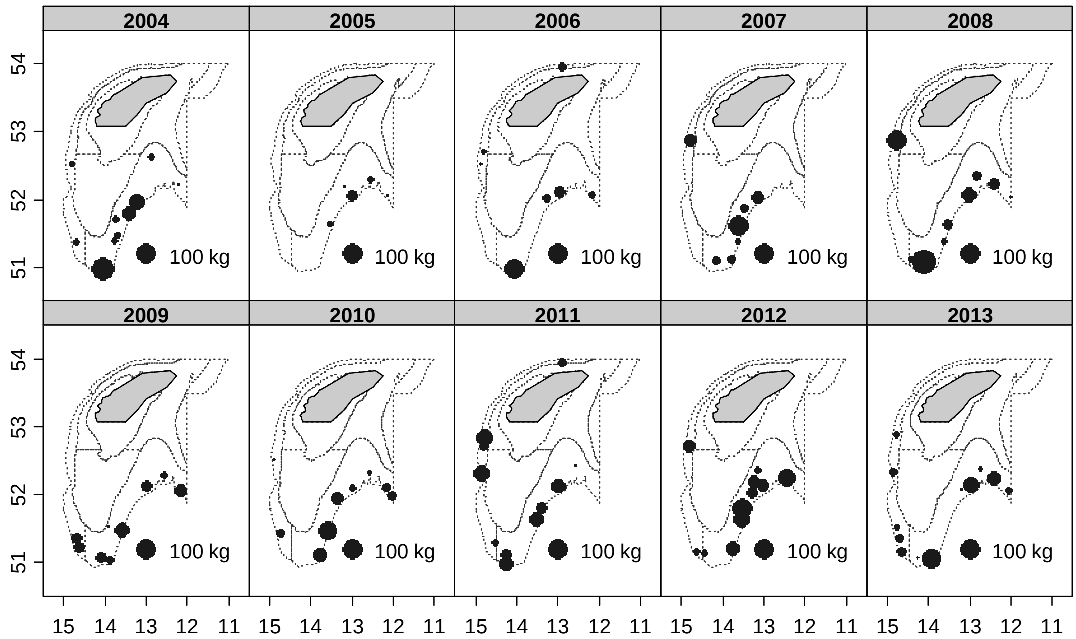

Figure 17 Geographic distribution of *Scymnodon ringens* catches (kg·haul^{-1}) during Porcupine survey time series (2004- 2013).

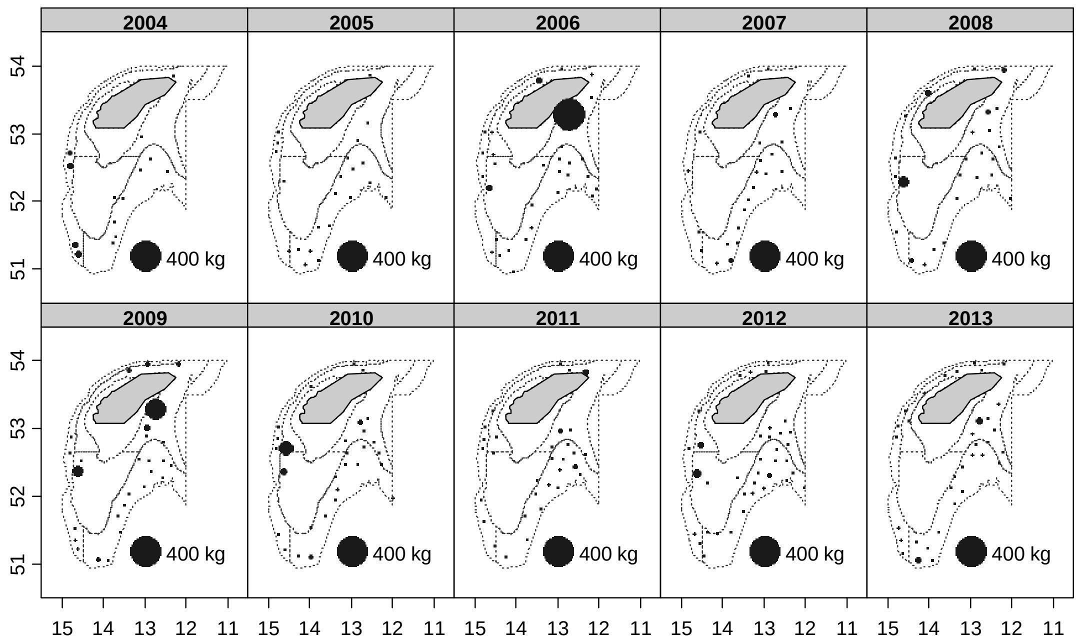

Figure 18 Geographic distribution of *Etmopterus spinax* catches (kg·haul^{-1}) during Porcupine surveys time series (2004- 2013).

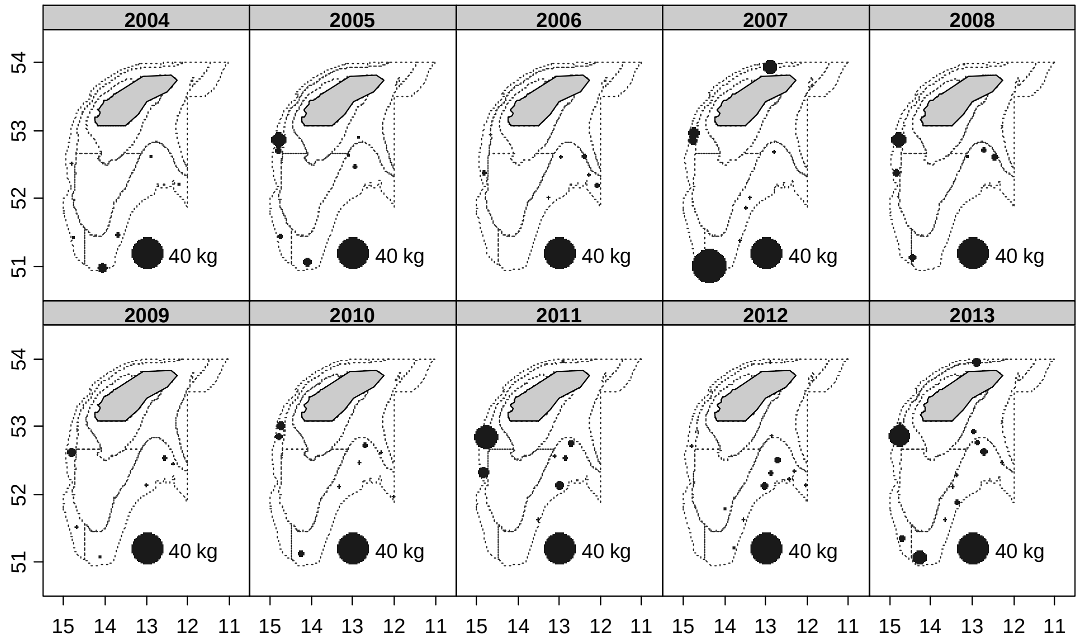

Figure 19 Geographic distribution of *Dalatias licha* catches (kg·haul^{-1}) during Porcupine surveys time series (2004- 2013).

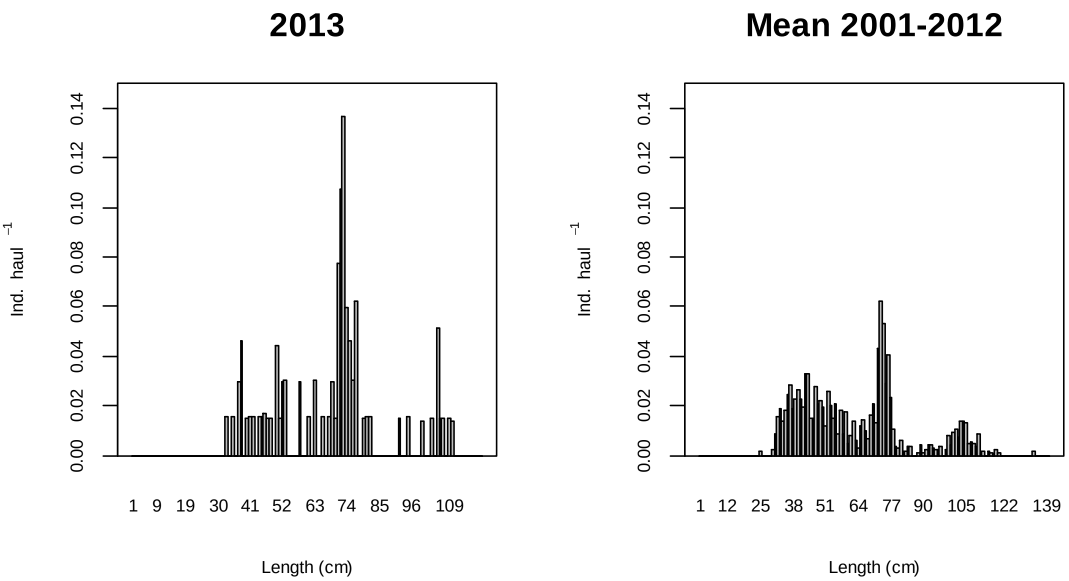

Figure 20 Stratified length distribution of *Scymnodon ringens* in 2013 in Porcupine survey, and mean values during Porcupine survey time series (2001-2012).

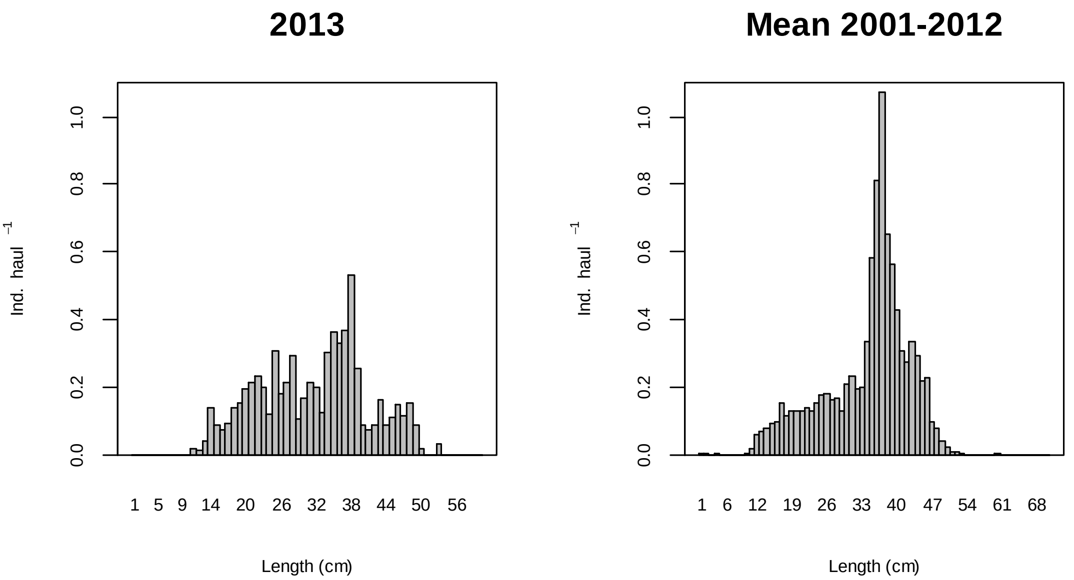

Figure 21 Stratified length distributions of *Etmopterus spinax* in 2013 Porcupine survey, and mean values during Porcupine survey time series (2001-2012).

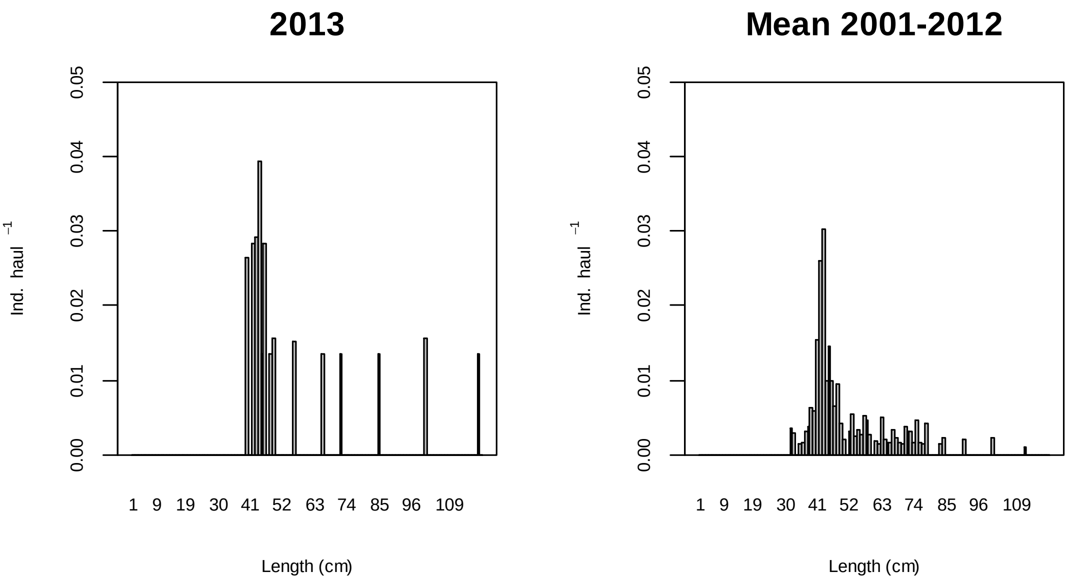

Figure 22 Stratified length distributions of *Dalatias licha* in 2013 Porcupine survey, and mean values during Porcupine survey time series (2001-2012).

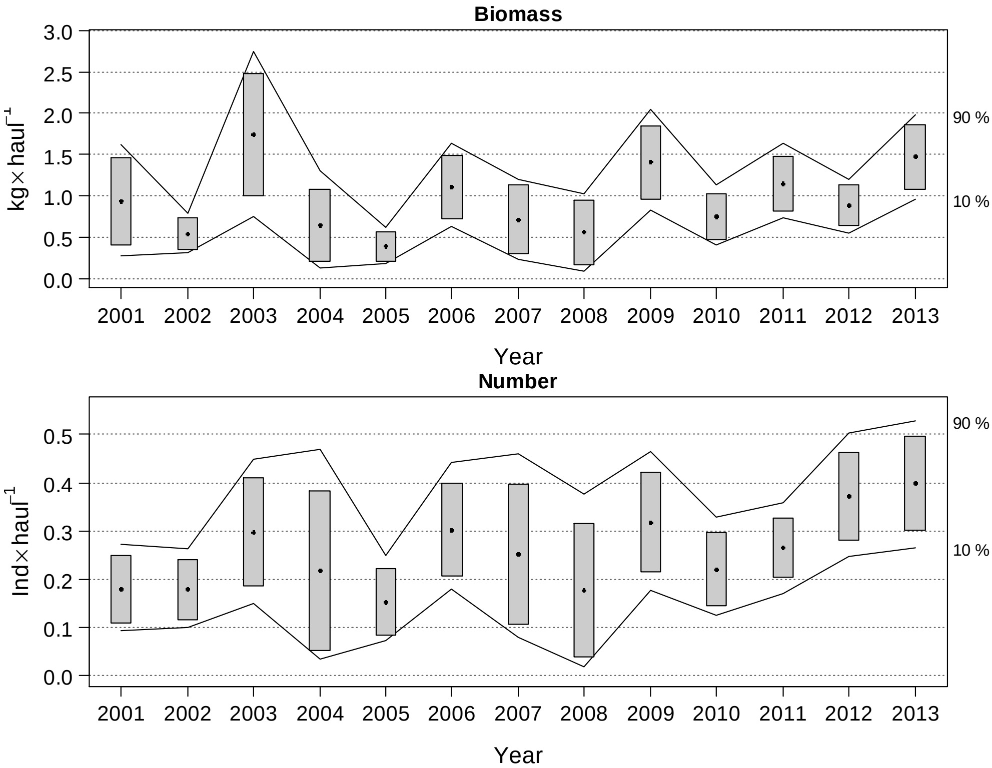

Figure 23 Changes in *Hexanchus griseus* biomass index (kg·haul^{-1}) during Porcupine survey time series (2001-2013). Boxes mark parametric standard error of the stratified biomass index. Lines mark bootstrap confidence intervals (a = 0.80, bootstrap iterations = 1000).

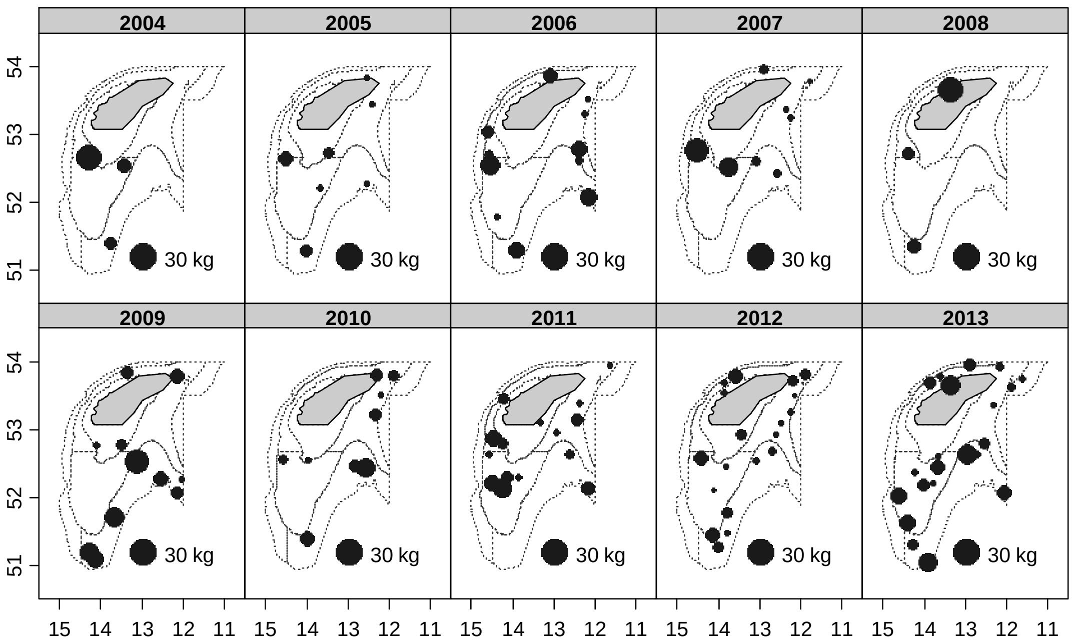

Figure 24 Geographic distribution of *Hexanxchus griseus* catches (Kg·haul^{-1}) in Porcupine surveys (2004-2013).

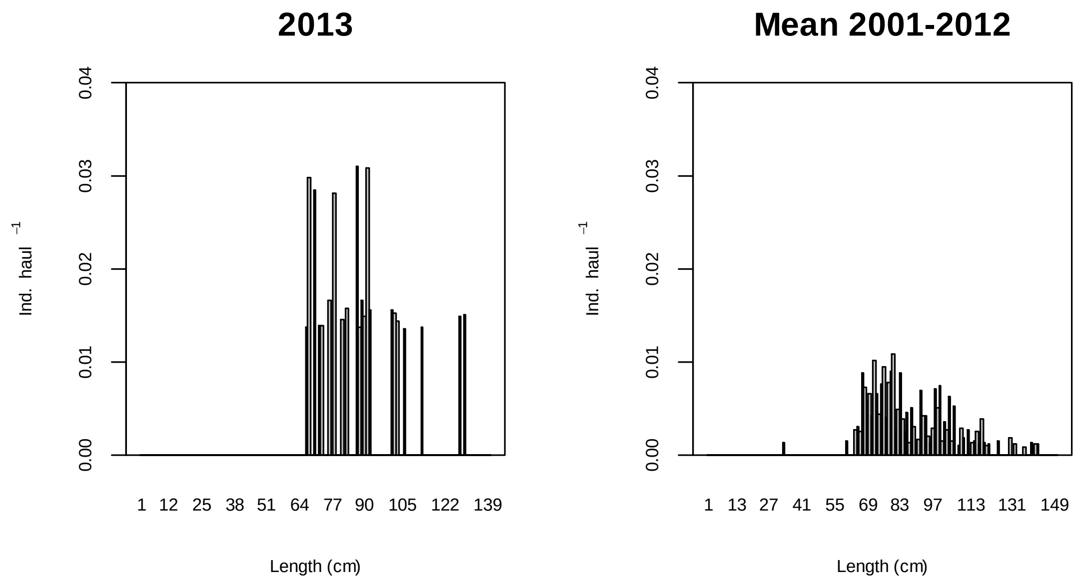

Figure 25 Stratified length distributions of *Hexanchus griseus* in 2013 Porcupine survey and mean values during Porcupine survey time series (2001-2012).

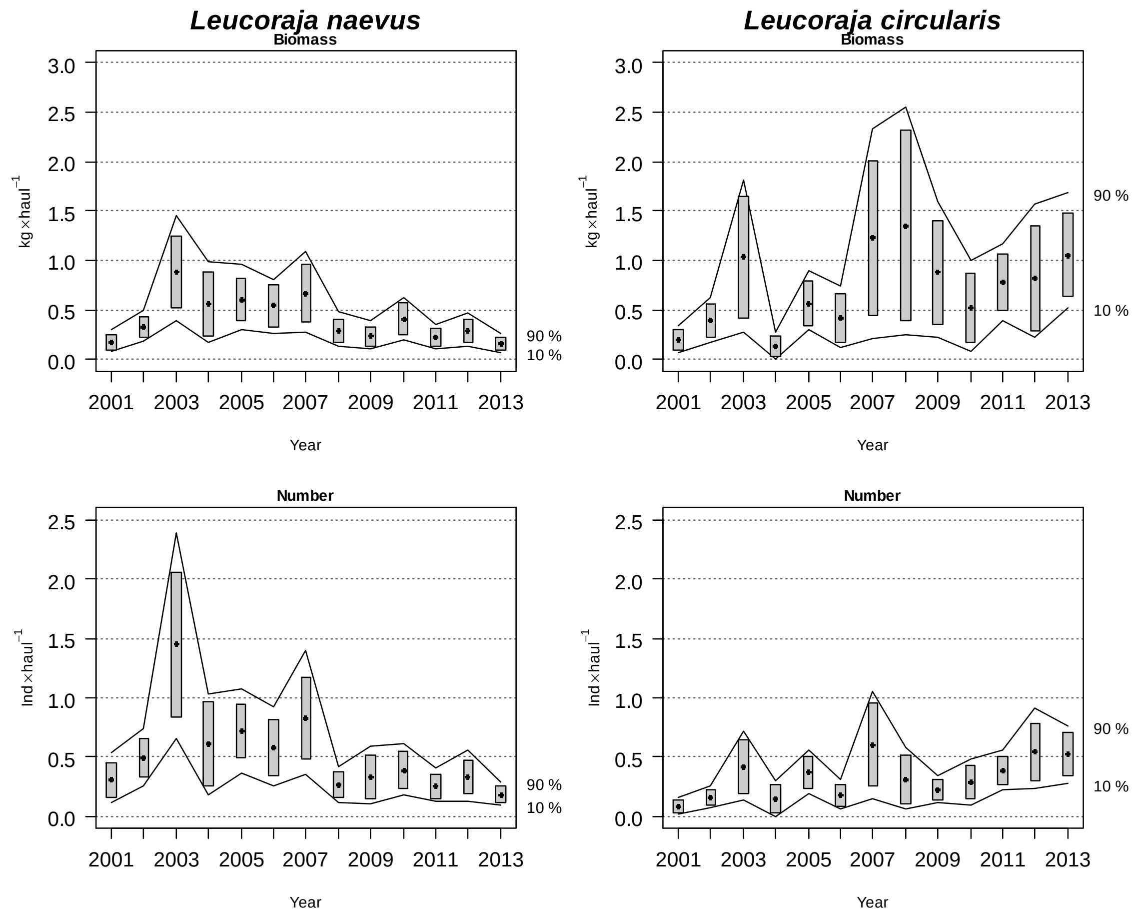

Figure 26 Changes in *Leucoraja naevus* and *Leucoraja circularis* biomass index (kg·haul^{-1}) during Porcupine survey time series (2001-2013). Boxes mark parametric standard error of the stratified biomass index. Lines mark bootstrap confidence intervals (a = 0.80, bootstrap iterations =1000).

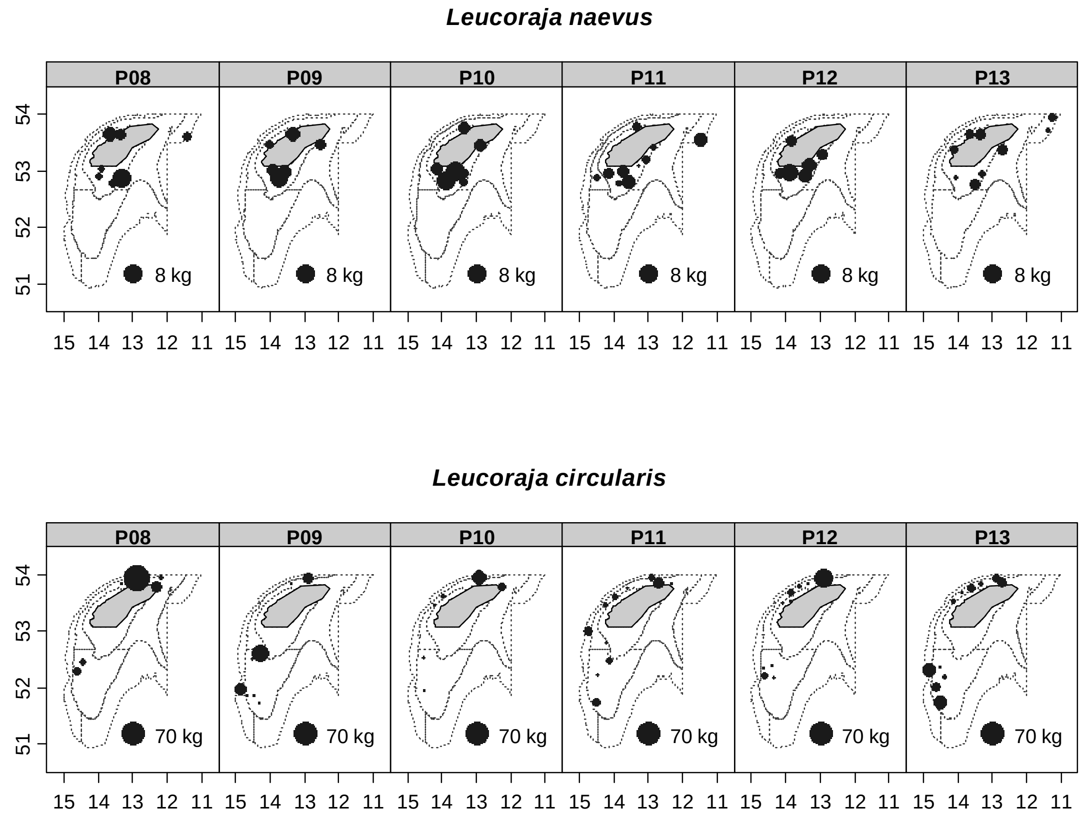

Figure 27 Geographic distribution of *Leucoraja naevus* and *Leucoraja circularis* catches ($kg \cdot haul^{-1}$) in Porcupine survey time series (2008-2013).

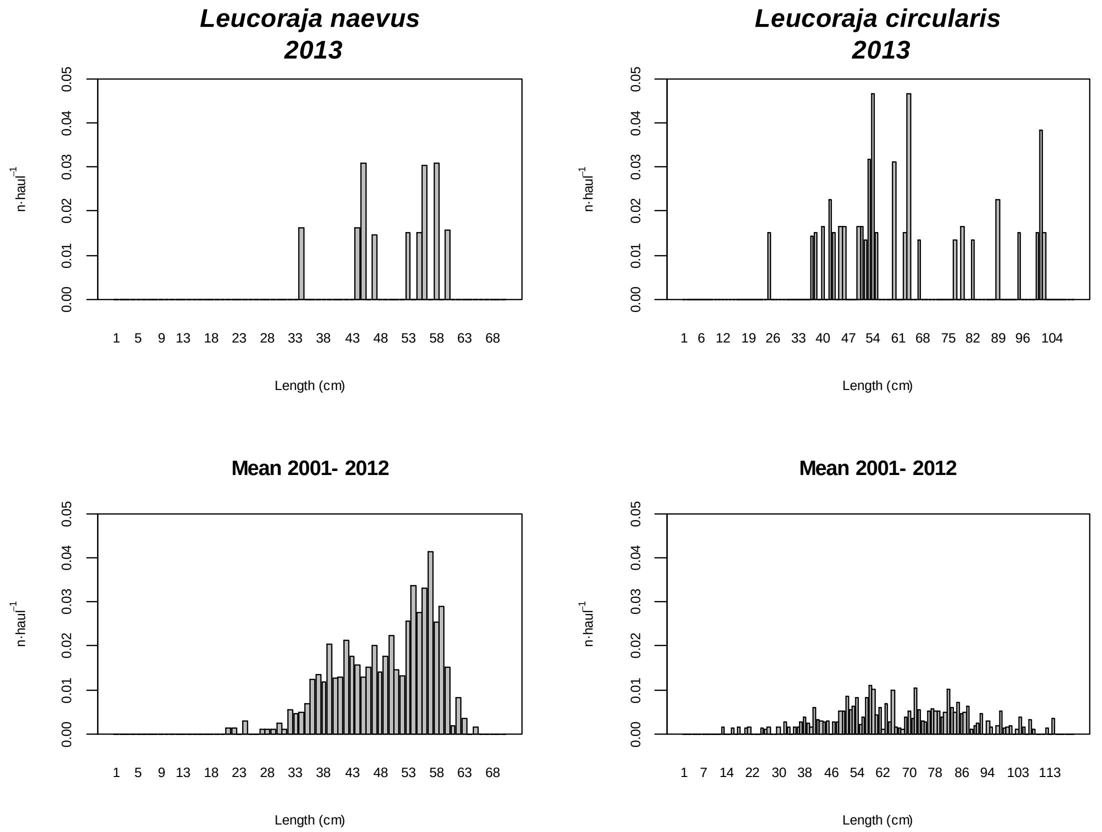

Figure 28 Stratified length distributions of *Leucoraja naevus* and *Leucoraja circularis* in 2013 Porcupine survey, and mean values during Porcupine survey time series (2001-2012).

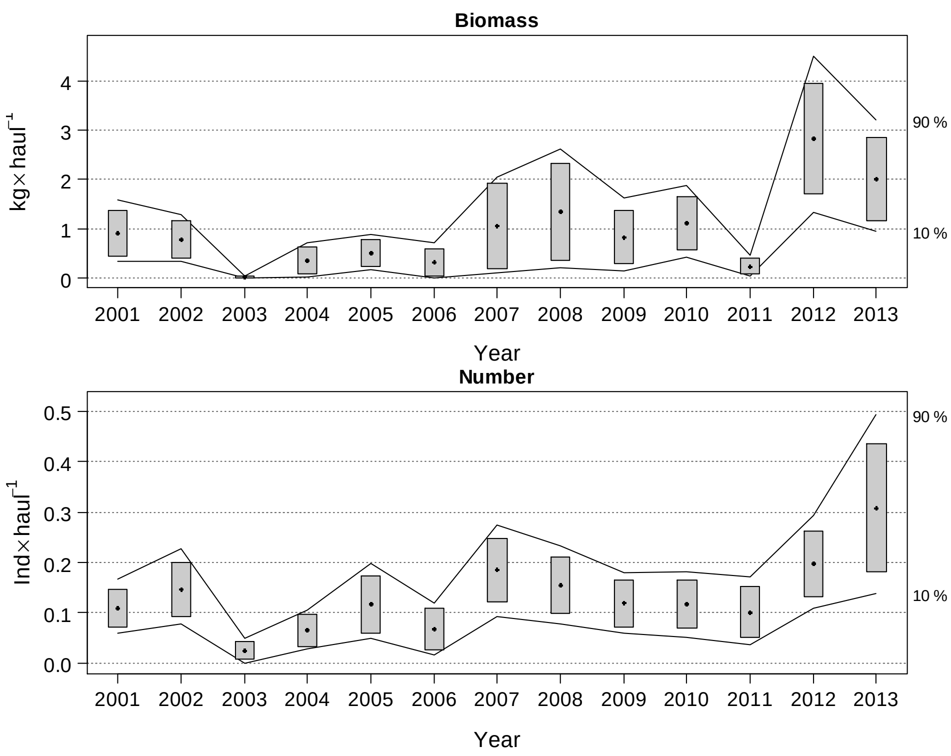

Figure 29 Changes in *Dipturus* spp. biomass index (kg.haul^{-1}) during Porcupine survey time series (2001-2013). Boxes mark parametric standard error of the stratified index. Lines mark bootstrap confidence intervals (a = 0.80, bootstrap iterations = 1000).

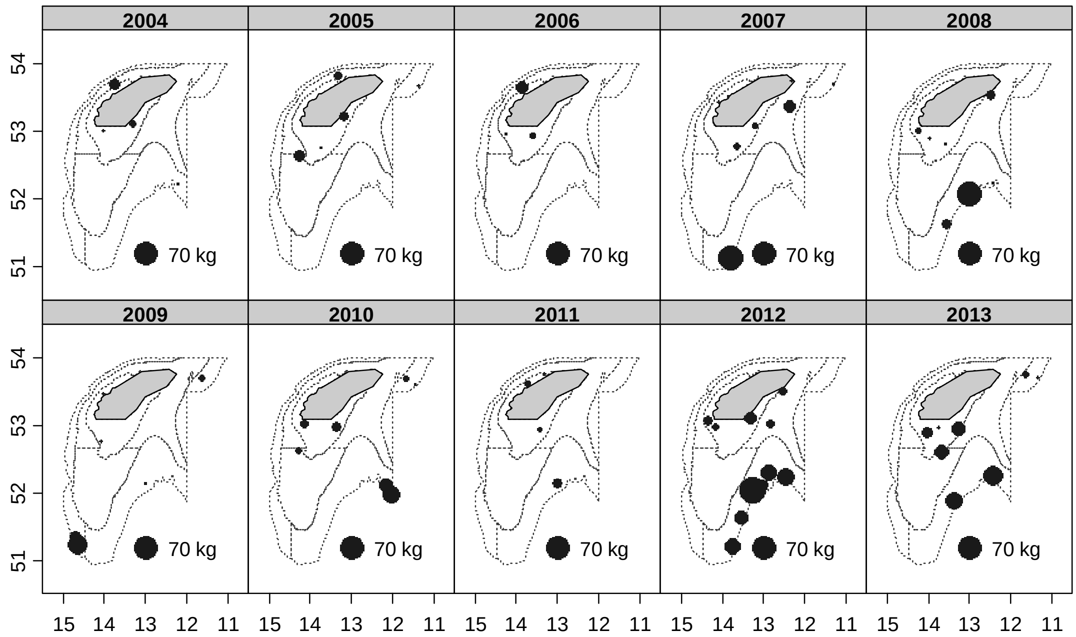

Figure 30 Geographic distribution of *Dipturus* spp. catches (Kg· haul^{-1}) in Porcupine survey time series (2004-2013).

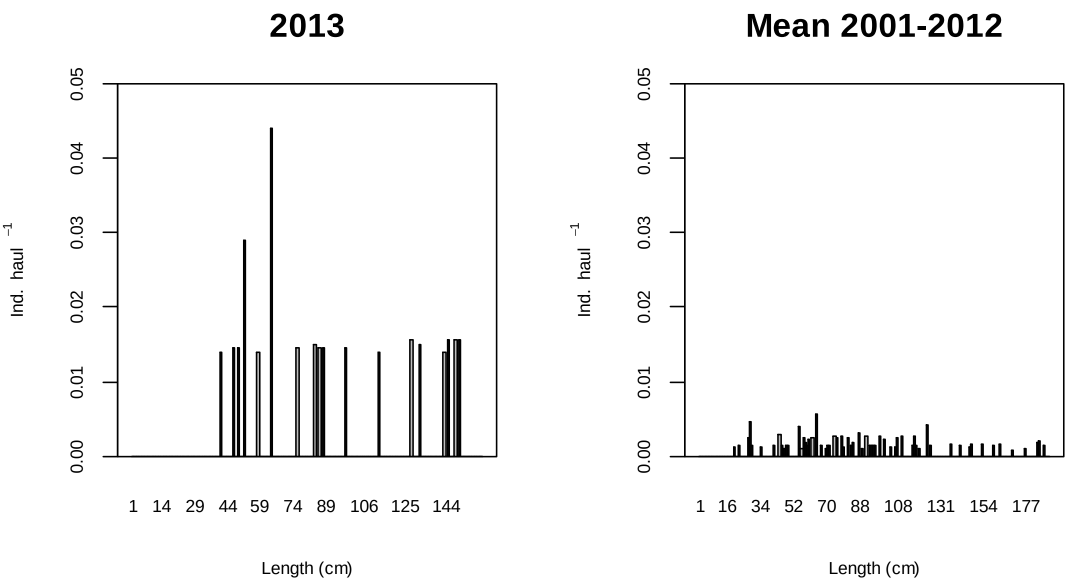

Figure 31 Stratified length distributions of *Dipturus* spp. in 2013 Porcupine survey, and mean values during Porcupine survey time series (2001-2012).

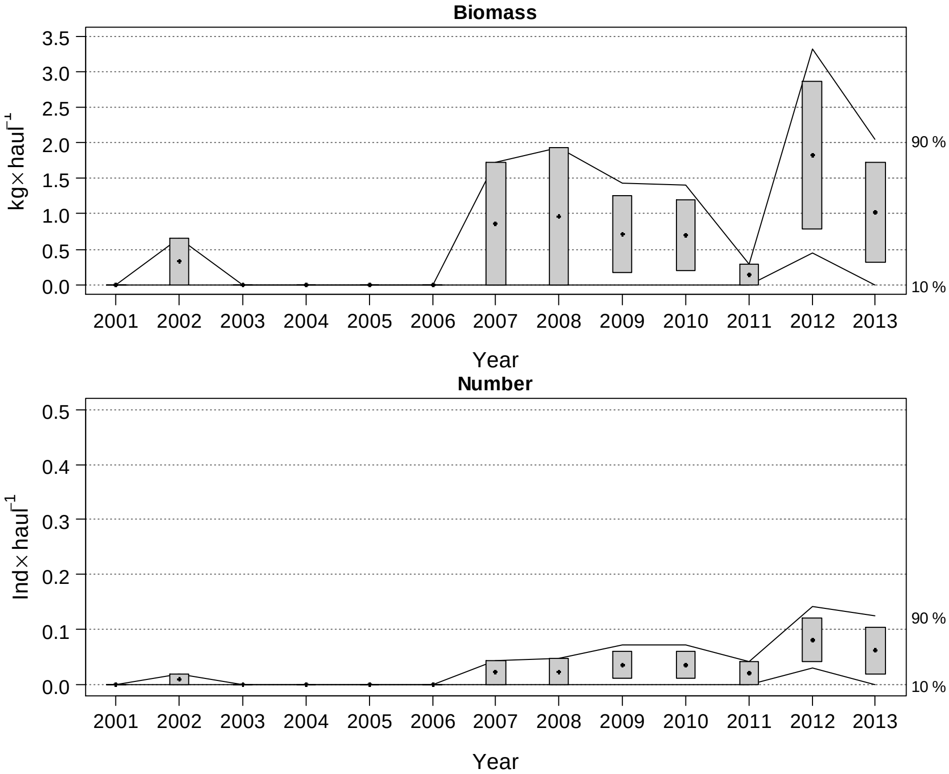

Figure 32 Changes in *Dipturus nidarosiensis* biomass index (kg· haul^{-1}) during Porcupine survey time series (2001-2013). Boxes mark parametric standard error of the stratified index. Lines mark bootstrap confidence intervals (a = 0.80, bootstrap iterations = 1000).

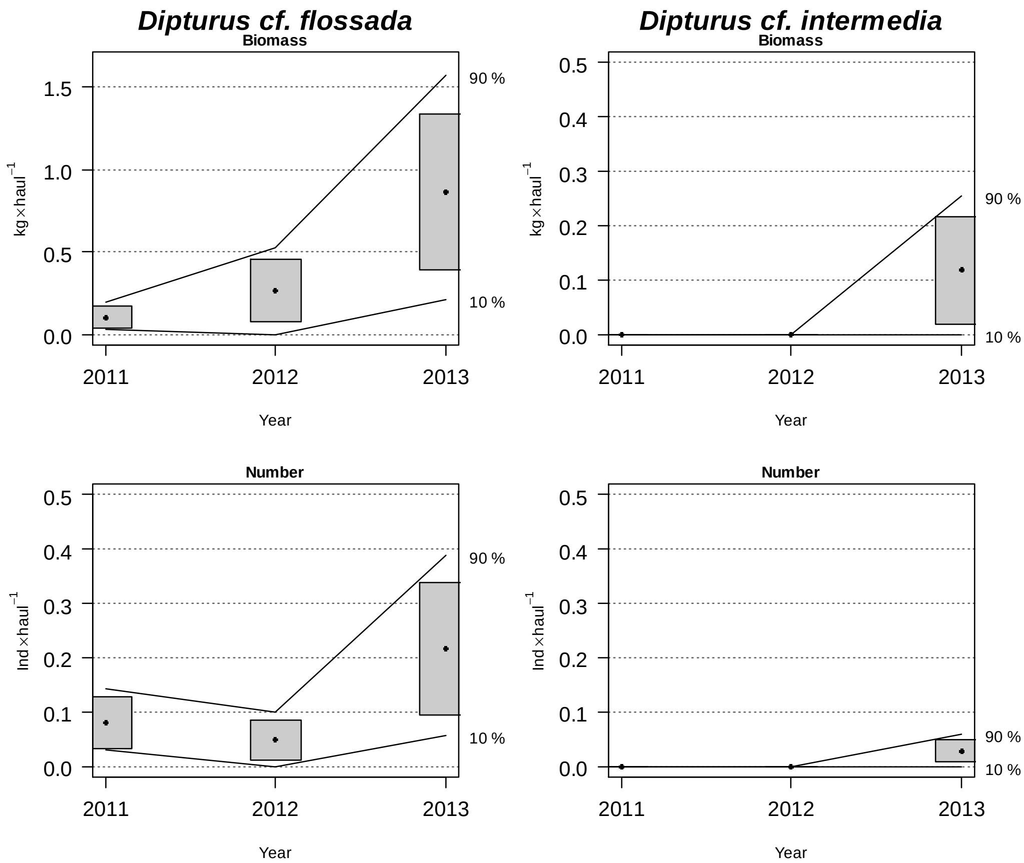

Figure 33 Changes in *Dipturus cf. flossada* and *Dipturus cf. intermedia*. biomass index (kg·haul^{-1}) during Porcupine survey time series (2011-2013). Boxes mark parametric standard error of the stratified index. Lines mark bootstrap confidence intervals (a = 0.80, bootstrap iterations = 1000).

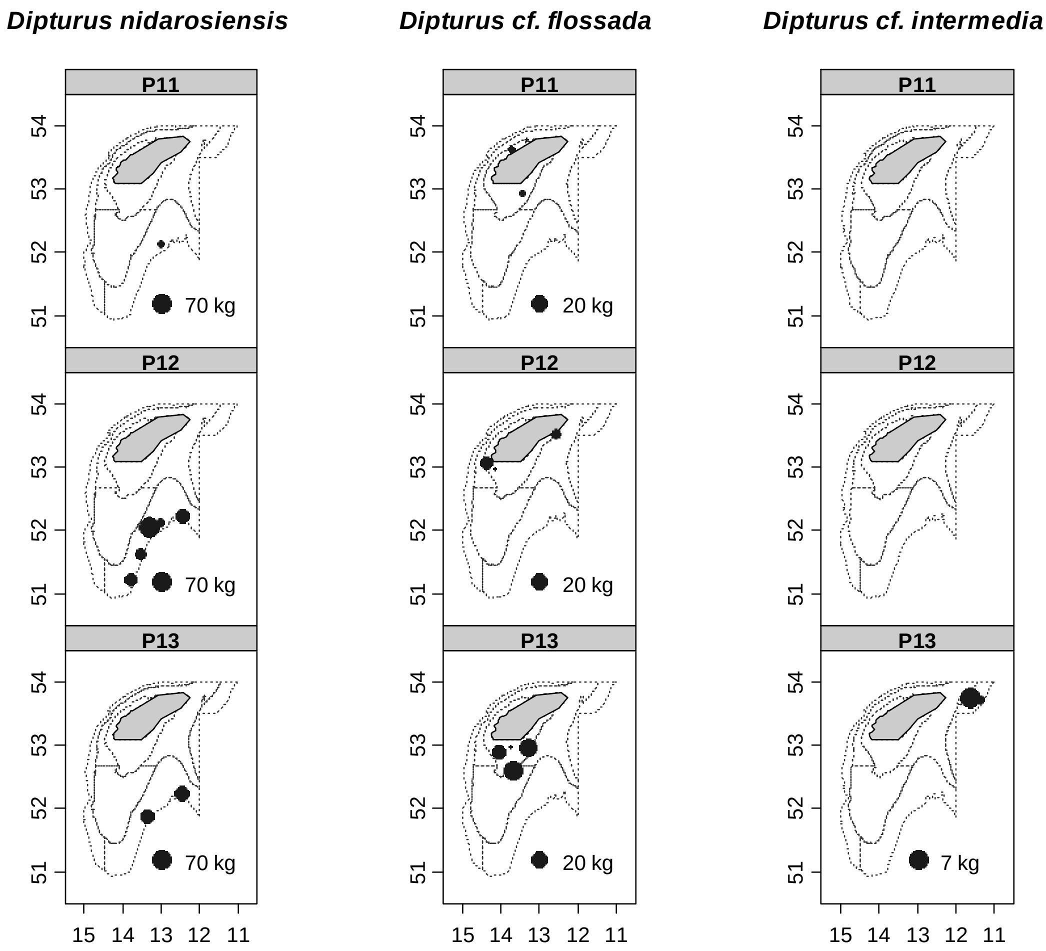

Figure 34 Geographic distribution of *Dipturus nidarosiensis*, *Dipturus cf. flossada* and *Dipturus cf. intermedia* catches (kg·haul^{-1}) in Porcupine survey between 2011 and 2013.

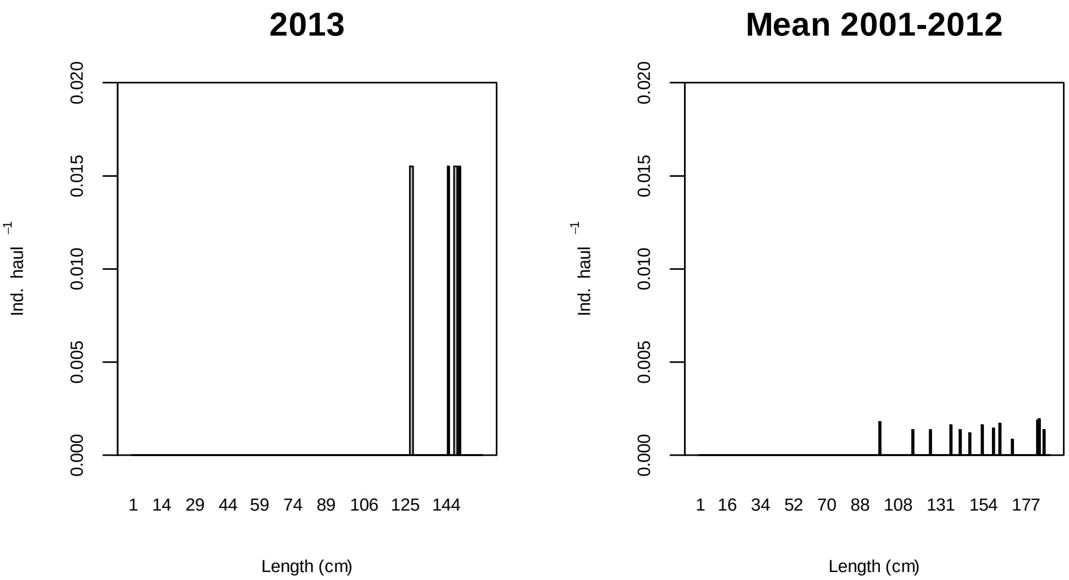

Figure 35 Stratified length distributions of *Dipturus nidarosiensis* in 2013 Porcupine survey, and mean values during Porcupine survey time series (2001-2012).

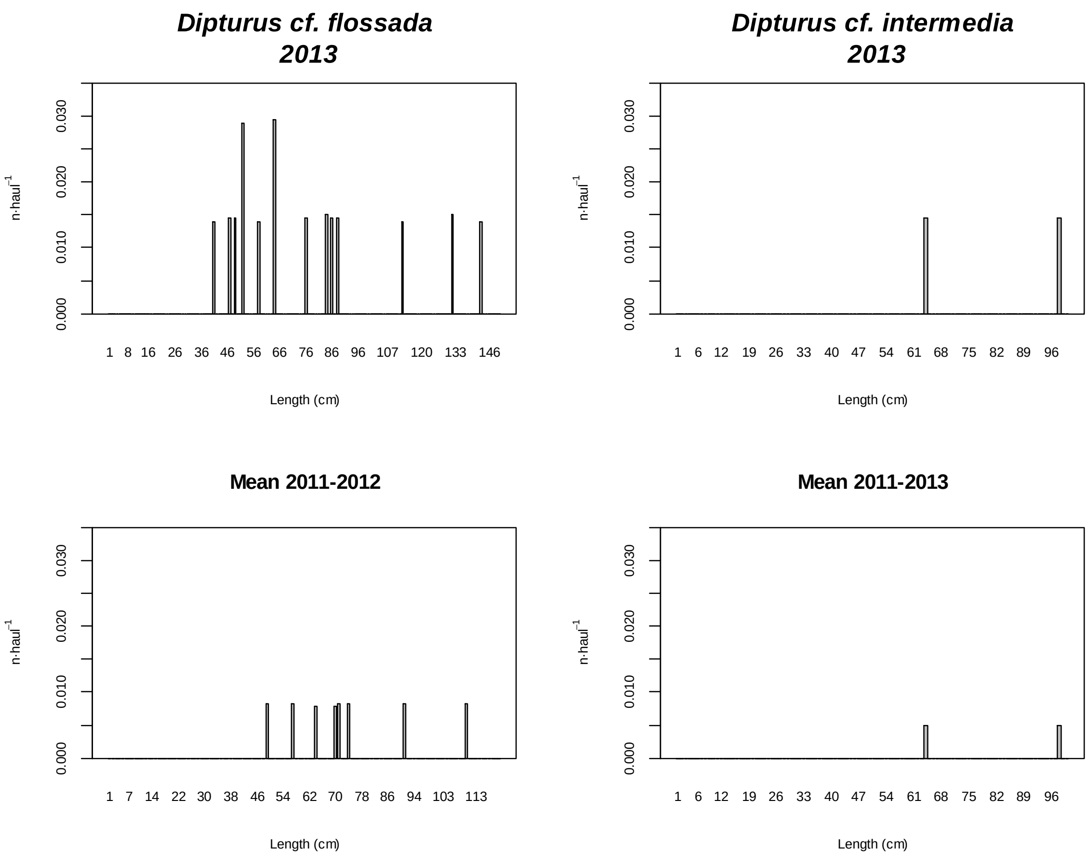

Figure 36 Stratified length distributions of *Dipturus cf. flossada* and *Dipturus cf. intermedia* in 2013 Porcupine survey, and mean values during Porcupine survey time series (2011-2012).